

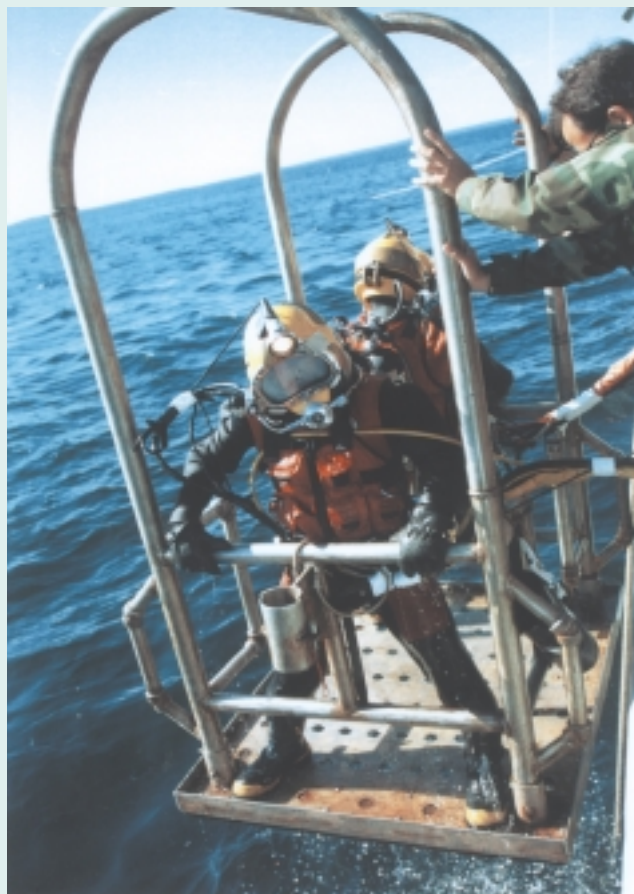
Prepared for All the Risks of Deep Diving

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For days in September 1998, the sound of divers breathing through their deep-sea helmets 180 feet below the surface vibrated over the loudspeaker of the mixed-gas console aboard the rescue and salvage ship USS *Grapple*. Canadian and American Navy divers worked in tandem, braving the cold waters of the Atlantic, to recover victims and debris from the crash site of Swiss Air Flight 111 near Peggy's Cove, Nova Scotia. *[Note: USS Grapple was the platform in this work. Divers from Mobile Diving Salvage Unit Two (MDSU-2) joined divers aboard Grapple. MDSU-2 divers used their new flyaway mixed-gas system, which marked the first time this system was used in auxiliary-rescue salvage.]*

When we got the call to help our Canadian counterparts in this mission, we knew we faced increased risk. Wrecked aircraft have lots of sharp metal surfaces, and we faced the long decompression times typical when using helium and oxygen (HeO₂) for deep diving and salvage work. *[Note: HeO₂ lets divers go deeper without the effect of nitrogen narcosis, an intoxicating effect similar to that of alcohol.]* In this case, though, there would be a problem we couldn't forget about, or it would sneak up on us before we knew it. That problem is oxygen toxicity in your central nervous system (CNS).

Recovery of the wreckage involved HeO₂ dives in 180 feet, with a bottom time of 40 minutes. Decompression time for these dives was 109 minutes. To have better control of the divers and to make it more comfortable for everyone, a recom-



Navy photo by PH1 Andy Mekaskle

Divers are raised out of the ocean after completing 40 minutes of recovery work at the crash site of Swiss Air Flight 111.

pression chamber was used for surface decompression. This option allowed us to do some in-water decompression, with the rest done in the chamber.



USS Grapple Sailors load debris from Swiss Air Flight 111 aboard a barge.

The most critical part of in-water decompression is when a diver is at the 50- or 40-foot decompression stop. At these stops in HeO₂ diving, 100 percent oxygen is used to speed up the decompression. It's then that CNS oxygen toxicity can sneak up on you. Some of the symptoms are vision problems, hearing difficulty, muscular twitching, nausea, irritability, dizziness, and the worst one, convulsions.

We came face to face with this toxicity during one of our dives. The dive side was manned, and everyone was at his station doing what he had been trained to do. This typical setting found tenders tending the divers' umbilical cords. Meanwhile, the standby diver and his tender were ready to help if needed, the phone talker was listening to the divers, and the console operator was watching the pressure gauges to ensure the divers had enough gas pressure. The master diver, who was the dive supervisor for the dive in progress, was checking to see if all the people were doing their jobs.

The pair of divers in the water had completed a routine dive and were decompressing at their 40-

foot stop. Everything was fine until red diver suddenly reported to topside that his buddy, green diver, had gone into convulsions. After ensuring that red diver had control of his buddy, the master diver deployed the standby diver to help.

Green diver regained consciousness briefly but went into convulsions again. Topside, the master diver told everyone there was an in-water casualty. The dive side was preparing to receive the divers when green diver again regained consciousness. Once red diver and the standby diver made sure green diver was OK and breathing on his own, all three divers were brought to the surface and completed their decompression in the chamber.

CNS oxygen toxicity doesn't happen on every HeO₂ dive. As the *U.S. Navy Diving Manual* points out, susceptibility varies from one person to another. The manual also says individual susceptibility varies from time to time, and, for this reason, divers may experience the toxicity at exposure times and pressures they previously tolerated. Because it's the partial pressure of oxygen itself that causes the toxicity, the problem can occur when mixtures of oxygen with nitrogen or helium are breathed underwater. [Note: In a gas mixture, the portion of the total pressure contributed by a single gas is called "partial pressure."]

The actual mechanism of CNS oxygen toxicity remains unknown, but prevention is the key. The diving manual warns divers to take sensible precautions anytime they use high pressures of oxygen. "Make sure the breathing apparatus is in good order, observe depth-time limits, avoid excessive exertion, and heed abnormal symptoms that may appear," the manual says.

As Sailors, it's our job to go where duty calls and do jobs that often are dangerous. We cannot remove all the risks, but with operational risk management (ORM), we can sort out those risks that are necessary and operate at the safest level possible to accomplish the mission. 🌐

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If you're interested in becoming a Navy salvage diver, contact your command career counselor.